

THE AMES

# Astrogram

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AMES RESEARCH CENTER, MOFFETT FIELD

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on-line at: <http://amesnews.arc.nasa.gov>

## Ames steps boldly forward with NASA Research Park

Ames Research Center and Lockheed Martin officials signed an historic agree-

ment on March 22, one that promises to change the face of the Center as we know it. The Space Act Agreement between the two parties commits both sides to initiating the development of a collaborative research and office complex at Moffett Field in the NASA Research Park (NRP) currently being planned.



The plan map shows the location of the Lockheed Martin lab project in the NASA Research Park.

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In its simplest terms, the agreement provides for mutual collaboration in "astrobiology, aerospace, information technology, science education, and space commercialization." Discussions of potential areas for research and technical collaboration have been ongoing for about 15 months, since Jan. 2000, when Ames and Lockheed Martin officials inked a planning memorandum of understanding that culminated in the recent signing.

"This is the first step to the new Ames," said Ames Center Director Dr. Henry McDonald as he signed the historic Space

Act Agreement with Lockheed Martin Space Operations President Jay F. Honeycutt during the recent ceremony. "I think we can all be very proud of what has been, and will be, accomplished. I believe that, in retrospect, we will come to view this day as one of the most significant in the evolution and growth of Ames Research Center, one that set the tone for the next 20 to 30 years and beyond."

The focus of the new collaboration centers on Lockheed Martin's plan to construct a laboratory for advanced science research, make sup-



Dr. Henry McDonald signs the recent agreement with Lockheed Martin space operations president Jay Honeycutt to develop a research and office complex in NASA Research Park.

photo by Dominic Hart

porting infrastructure improvements, and develop an office complex in the NRP. The company will also contribute to an independently established non-profit research fund in support of science and technology research throughout the NRP.

It is anticipated that research will encompass the disciplines of astrobiology, life

*continued on page 9*



Artist's conceptual drawing shows the view from the Lockheed Martin lab project looking towards the NASA Research Park.

Communication for the information technology age

Special Shuttle 20th Anniversary Commemorative Issue

### Be a visiting astronomer in Bay Area schools

Project ASTRO is searching for amateur (or professional) astronomers who would like to work with teachers and students in 4th - 9th grade classrooms. This is a great opportunity to help kids learn science, while sharing the wonder of astronomy with the most enthusiastic audience you can find. You can even sharpen your own teaching or communication skills in the process while receiving free training and materials from Project ASTRO.

Through Project ASTRO, you will be paired in a one-on-one partnership with a Bay Area teacher at a school near you. Together, astronomer and teacher partners attend a free two-day summer training workshop where they learn effective hands-on astronomy activities. All participants also receive a copy of Project ASTRO's 800-page curriculum resource book, "The Universe at Your Fingertips."

The project emphasizes ongoing partnerships, not just one-time class visits. During the school year, astronomers make at least four visits to their adopted classrooms at mutually convenient times. The program has been operating for seven years in the Bay Area. Previous participants typically report that it is one of the most satisfying volunteer endeavors they have ever under-

taken.

No formal educational background in astronomy is required. Enthusiasm for sci-



ence and a love of kids is much more important. You should just feel comfortable answering basic questions and work-

ing with a teacher who will be delighted to have you come to his or her classroom.

Astronomer applications are now being accepted for the 2001 - 2002 school year. The established deadline is April 27, but late applications are often accepted.

Space is limited to 20 - 25 partnerships. All participants are required to attend the training workshop, to be held August 3 - 4, 2001, at the San Mateo County Office of Education in Redwood City.

Project ASTRO, a program of the non-profit Astronomical Society of the Pacific, began with support from the National Science Foundation and the NASA Office of Space Science. It has now expanded to 11 other sites around the country and has trained over 900 astronomer-teacher partnerships.

Astronomer application forms are available from:

Karin Avila, Project ASTRO,  
Astronomical Society of the Pacific  
390 Ashton Avenue  
San Francisco, CA 94112;  
(415) 337-1100, ext. 101  
e-mail: [astro@aspsky.org](mailto:astro@aspsky.org)

Forms can also be downloaded at:  
[www.aspsky.org/astro/volunteer.html](http://www.aspsky.org/astro/volunteer.html).

BY KARIN AVILA



### New Ames "traffic light" accelerates computers

Ever hear of a traffic light that actually speeds things up? New software developed by Ames scientists promises to do just that.

Known as the Portable Batch System (PBS), the software enables system administrators to specify the order in which individual programs are processed. The Information Power Grid (IPG) program, led by Ames, is collaborating with Veridian Systems, Inc. to enhance this unique computer batch processing system.

"When you start a computer program, it competes with all other programs running in your system for resources such as memory," said David Tweten, former project lead for PBS at Ames. "This often makes your computer slow and inefficient. The Portable Batch System, by contrast, prioritizes the programs and keeps them from starting until the resources they need become available."

The highlight of the software is its flexibility. "The system administrator can use various categories to prioritize the programs and express any batch processing policy he or she wants," explained Tweten. In addition, PBS operates in multi-platform UNIX environments, allowing all systems,

regardless of size or configuration, to utilize this software.

"PBS was originally designed by NASA because existing resource management systems were inadequate for modern parallel/distributed computers and clusters," said James Patton Jones, business director for Veridian's PBS products department. "It takes a new approach to resource management and job scheduling, such as the extraction of scheduling policy into a single separable, completely customizable module. The new commercial version includes many new features, as well as greatly improved support for workstation clusters," said Jones.

The Veridian PBS products department developed the original version of PBS for NASA and received permission from Ames to assert copyright several years ago. Last year, Veridian released an enhanced commercial version of the software called PBS Pro. Ames' IPG team and Veridian now are collaborating in the area of computational grid technology trying to identify and implement additional computational grid features in PBS Pro.

In addition to working with IPG, Veridian

is expanding the use of the commercial version of PBS with new features and enhancements, including versions for Windows 2000 and Mac OS/X; a new web-based user interface; and providing tighter integration with various other computer systems.

This successful transfer of PBS software demonstrates how NASA's Commercial Technology Offices pursue their mission to maximize NASA's research efforts. NASA reaches out to the business community in a way that leverages the agency's resources with those of the private sector. The objective is to stimulate job growth and increase the competitiveness of American products in the global marketplace.

"It becomes very evident to the American taxpayer that their investment is paying off when products like PBS are spun out and become commercially viable, solving a real need," said David Lackner of the Ames Commercial Technology Office.

BY VICTORIA KUSHNIR



## Center Briefs

### Colliding solar eruptions pack punch

Fast-moving solar eruptions apparently overtake and often devour their slower kin. This discovery was made by a team of astronomers working with a tandem of NASA spacecraft.

Strange radio fireworks were heard by the team using NASA's Wind spacecraft. The link to the cosmic collisions came when researchers linked the timing of the radio outbursts to images of solar eruptions consuming each other captured by the Solar and Heliospheric Observatory (SOHO) spacecraft from NASA and the European Space Agency (ESA).

Solar eruptions directed at Earth are potentially harmful to advanced technology, including communications and power systems.

### 2001 Mars odyssey set to go

When NASA's 2001 Mars Odyssey launches in April to explore the fourth planet from the sun, it will carry a suite of scientific instruments designed to tell us what makes up the martian surface and provide vital information about potential radiation hazards for future human explorers.

"The launch of 2001 Mars Odyssey represents a milestone in our exploration of Mars -- the first launch in our restructured Mars Exploration Program we announced last October," said Dr. Ed Weiler, Associate Administrator for Space Science, NASA Headquarters, Washington, DC.

### Rocket, please "phone home"

Imagine a day when self-diagnostic tools allow future rockets to phone home with vital information about their condition, location and performance. NASA engineers hope that day comes sooner than later and believe the technology could replace expensive ground systems, reducing the cost of space flight.

The "Flight Modem," being developed at the NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, VA, allows a rocket or any other flight vehicle to communicate with ground controllers without the traditional and costly equipment typically associated with flight missions.

### Successful X-40A test flight

The X-40A glided to the runway at Edwards Air Force Base, rolling to a gentle stop, with no pilot. The X-40A flew itself, guided by its on-board systems.

"It was truly a beautiful sight and cause for celebration," said Susan Turner, NASA's X-37 program manager at Marshall Space Flight Center in Huntsville, AL.

The X-40A's free flight and landing was conducted as part of the X-37 program, intended to reduce the risk of flight-testing the X-37, not from 15,000 feet like the X-40A, but from low-Earth orbit. The X-37 is an experimental re-entry vehicle that will enable NASA to test advanced technologies in the harsh environment of space and in returning through Earth's atmosphere.

## Ames-developed scanner helps the search for shuttle tile flaws

NASA workers who face the critical and often tedious task of evaluating damage to the space shuttle's protective thermal tiles now have some high-tech help in the form of a new portable, digital inspection system.

Engineers from Ames' Sensors and Instrumentation Branch in the Space Projects Division and the Boeing Co., Huntington Beach, CA, recently delivered a hand-held laser scanner to Kennedy Space Center for evaluation.

"Tests at Ames and at Kennedy have demonstrated the scanner's ability to measure surface flaws on thermal protection tile and blanket samples," said Joseph Lavelle, Ames' senior project engineer.

The shuttle's thermal tiles protect the orbiter and its crew from temperatures ranging from minus 250 degrees Fahrenheit in space, to nearly 3,000 degrees Fahrenheit during the superheated reentry. After each flight, every one of the more than 24,000 tiles that cover the shuttle's surface must be inspected.

The scanner uses a digital camera and lasers in a measurement technique called laser triangulation. It is the first step toward the development of an electronic inspection and mapping system (EIMS) that could aid the evaluation of the shuttle's thermal protection system (TPS).

"This new scanner, along with the rest of the EIMS currently in development at Kennedy, could increase the accuracy and reliability of our damage measurements," said Suzy Cunningham, Kennedy's TPS project manager. "The system could make the inspection process more efficient, which eventually could reduce vehicle turn-around time. Tile inspection is a very time-consuming process."

The hand-held instrument is a 5-inch-by-9-inch box that, when placed over a tile, measures flaws within a 3-inch-by-3-inch area. The scanner sends the data to a laptop computer. Software locates and characterizes the damage and generates a 3-D image, indicating the size and depth of the flaw. The system also contains a database of tile fabrication and maintenance information for every tile on the orbiter being measured. The latest TPS information and updates for each of NASA's four shuttles can be downloaded from a computer.

"A major challenge has been reducing the size of the system so it fits into small areas, such as those around the scaffolding that surrounds the orbiter during its post-landing maintenance," noted Lavelle. "With input from Kennedy engineers and United Space Alliance (USA) technicians, we have been very aggressive about making the scanner smaller," he stated.

The software also offers USA technicians various repair options. "Our California developers are writing software that integrates systems developed by Ames, Boeing Florida Operations at Kennedy, and Boeing-Huntington Beach," said Claudia Silverman, Boeing project manager at the Huntington Beach facility. "We are proud of the product and the team effort."

Lavelle said this electronic inspection technology also may have applications in other fields, such as integrated circuit inspection and in any manufacturing process that requires high accuracy.

"With the first phase of this project completed, we have already seen tremendous teamwork between NASA's field centers and the contractors," added Cunningham. "This is a clear indication of the cooperation we'll see as we develop a complete system."

Images of the scanner are available on the Internet at: <http://amesn.ews.arc.nasa.gov/releases/2001/01images/scanner/scanner.html> or at: <http://www-pao.ksc.nasa.gov/kscpao/captions/hotpics.htm>

BY ANN HUTCHISON



### VPP STAR Tip

*"The site culture must enable and encourage effective employee involvement in the planning and operation of the safety and health program and in decisions that affect employees' safety and health."*

*...Federal Register 65:45649-45663*

## Teamwork is the key in FIRST robotics competition

Part rock concert, part sporting event, the FIRST Robotics Silicon Valley regional was two days of intense competition to determine the top high school teams in the western United States. Co-sponsored by Ames Research Center, academic and in-

where the sole purpose is to destroy your opponent, the one run by the FIRST (For Inspiration and Recognition of Science and Technology) organization, which holds multiple regionals and a national championship, teaches teamwork. Teams of four

robots had to work together to accomplish certain tasks within 2-minute contests.

Total points were awarded for the number of tasks accomplished multiplied by the time remaining. To emphasize teamwork, the composition of the teams changed during each of the 104 preliminary matches. Individual robot tasks were determined based on each robot's capabilities during the brief strategy meeting before each match.

Teamwork was very evident both in and out of the arena. In a few matches, disabled robots were pulled to the other side of the arena on a stretcher, and robots that were trapped in a barrier were given a helping hand. In the pit area, teams shared parts, engineering experience and tools. To receive help, all a team needed to do was ask a team around them. Also, each of the 22 rookie teams had at



photos by Jonas Diño

Rookie Team 632 performs a system check before their next match.

least one veteran team that served as a mentor.

Teamwork also extended to the mentors and volunteers who made this event possible. Mentors from Ames spent countless hours providing everything from engineering experience and sponsor contacts to transportation to the event. An army of volunteers from Ames, some including their families, also provided logistical support: staging robots, resetting the arena and providing crowd control.

The FIRST Robotics Regional is one of many robotics programs supported by Ames. The Ames Robotics Education Project also supports Botball and FIRST Lego League.

For more information about the Silicon Valley Regional or the Robotics Education Project, visit their web site at: <http://robotics.arc.nasa.gov>.

BY JONAS DIÑO



Student teams position their robots for the next match as volunteers prepare the arena and direct traffic.

dustry partners, the event was held at the San José State Events Center on March 23-24.

Fifty-two high school teams, including 22 rookie teams from as far away as Alaska and Hawaii, competed, bringing cheering sections complete with matching t-shirts, colored hair, drums and mascots.

Unlike other robotics competitions

## Laughlin to speak on fate of the universe

On Wednesday evening, April 11, at 7 pm, Dr. Greg Laughlin of Ames will give an illustrated talk on "The Long Term Future of the Sun, the Earth, and the Solar System" in the Silicon Valley Astronomy/Astrobiology Lecture Series, at Foothill College in Los Altos Hills. Admission is free and the public is invited. The non-technical program will focus on the fate of our planet (and its neighbors) over billions of years of future history. Using sophisticated computer models (and information from other stars), astronomers can now predict how our sun will age and eventually die. In the process, it will swell up and become larger than the current orbit of the Earth. Come and find out what will happen to our planet (and others) in the process.

Greg Laughlin is a research scientist at

Ames who has also worked at the University of California, Berkeley, and the National Observatory of Japan. He is co-author of the widely-praised popular book, "The Five Ages of the Universe: Inside the Physics of Eternity" (1999, Simon & Schuster).

The program will be held at Foothill's Smithwick theater in Los Altos. From Interstate 280, exit at El Monte road and travel west to the campus.

The program is cosponsored by Ames, the Astronomical Society of the Pacific, and the SETI Institute. An average of 900 people have attended the lectures in this series this past year.

Seating is on a first-come, first-served basis. Children over 13 are welcome.

SILICON VALLEY ASTRONOMY LECTURE SERIES  
With a Special Focus on Astrobiology

*The Long Term Future of the Sun, the Earth, and the Solar System*

Speaker: **Greg Laughlin**  
NASA Ames Research Center  
Foothill College  
The Astronomical Society of the Pacific  
The SETI Institute

**April 11, 2001  
7:00pm - 8:30pm**

A free, non-technical program focusing on the ultimate fate of our planet and the solar system. Come and find out what will happen to our planet (and others) in the process.

Sponsored by:  
**Dr. Gregory Laughlin**  
NASA Ames Research Center

Smithwick Theater  
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Call 408-949-7888 for more information



## 20th Space Shuttle Anniversary

### A look back at Ames' contributions to the shuttle

April 12 marks a historic milestone in the human exploration of space. It is the 40<sup>th</sup> anniversary of the flight of cosmonaut Yuri Gagarin, the first human to orbit the Earth. It also is the 20<sup>th</sup> anniversary of the flight of STS-1, the first orbital flight of the Space



Figure 1. STS-1 launched from KSC on April 12, 1981, with Commander John Young and pilot Robert Crippen.

Transportation System, or space shuttle. This truly remarkable achievement was the result of work by thousands of individuals at NASA Headquarters, NASA field centers, major portions of the aerospace industry and academia.

Research at Ames has played a key role in the evolution of the shuttle program from the very beginning. The shape of the orbiter has its roots in the "lifting body" research pioneered by "Sy" Syvertson, Ames' fourth director, and Al Eggers. Once its 1- to 2-week orbital mission is complete, the shuttle executes a de-orbit burn, which slows it for its descent into the atmosphere. Initial entry occurs at about Mach 25, or 25 times the speed of sound in air. During the high-speed portion of the entry, the vehicle holds a high angle of attack. It executes a "blunt body entry" maneuver pioneered by Ames' second director, H. Julian "Harvey" Allen for the Mercury/Gemini/Apollo programs. After a long and fiery entry, the vehicle continues to dissipate energy through a series of S-turns. It then goes into subsonic flight and lands, unpowered, ei-

ther at Dryden Flight Research Center or, as is most common today, at Kennedy Space Center (KSC). Astronaut pilots say the shuttle glides like a "falling brick," so being able to land unpowered is quite an achievement.

This article describes some of Ames' major contributions to the early development of the space shuttle and mentions a few of the many Ames employees whose contributions were crucial to the vehicle's development. These include contributions to the shuttle ascent aerodynamics/aerothermodynamics (a combination of aerodynamics and thermal effects), the thermal protection system (TPS) that prevents the orbiter from burning up during reentry, low-speed approach and landing technology and simulator research. The center's facilities that enabled these contributions also are briefly described.

Ames has supported space shuttle development for close to 30 years, beginning with the formation in the 1970s of a Shuttle Project Office, led by Victor Stevens and his deputy, Bob Nysmith. They managed projects at Ames at the request of the program's lead center, Johnson Space Center. Hans Mark, Ames' third director, played a key role in defining and directing Ames' involvement in the shuttle program. Various directorates at Ames provided staff and facilities to execute projects.

#### Aerodynamics of the Orbiter/Boeing 747 Ferry Configuration

One of Ames' first tasks was to understand the aerodynamics of the specially modified Boeing 747 used to ferry the orbiter from Dryden to KSC. The aerodynamics of the mated vehicles and the interference of flows between the vehicles had



Figure 2. 14-Foot wind tunnel model of space shuttle orbiter and 747 used to understand aerodynamics of mated vehicles.

to be well understood prior to committing to design and flight. Understanding the separation process of the 747 and the orbiter was another requirement. (Figure 2). Testing in Ames' 14-foot wind tunnel was a major contribution to the successful flight test of the 747/full-scale orbiter model Enterprise.

#### Ascent Aerodynamics/Aerothermodynamics

Ames made a huge effort to develop the aerodynamics and aerothermodynamics for the shuttle. Victor Peterson, former deputy director of Ames, has stated that over 50 percent of the wind tunnel testing conducted for the shuttle was done at Ames. Ames' contribution to these wind tunnel tests is a heritage of which we can all be very proud.

Nearly all the aerodynamic studies at Ames used the center's extraordinary collection of wind tunnels, including the 40-by 80-foot wind tunnel, 12-foot pressure wind tunnel, the 2-foot, 11-foot and 14-foot transonic wind tunnels, the 6-by-6 foot, 8-by-7-foot and 9-by-7-foot supersonic wind tunnels, and the 3.5-foot hypersonic wind tunnel. More than 10,000 hours of wind tunnel testing took place even before the award of the shuttle design and construction contract in 1972. More than 25,000 hours of wind tunnel testing occurred after this. Key contributors to the subsonic - supersonic elements of the activity included Richard (Pete) Peterson, Jake Drake, Dan Petroff, Jim Monford, Jack Bronson, Len Roberts and Jack Boyd.

Testing for the ascent stack (the orbiter, external tank and solid rocket boosters) aerodynamics and exhaust plume interactions was carried out in the 9-foot by 7-foot supersonic section of Ames' Unitary Plan wind tunnel. (Figure 3). These tests helped engineers ensure that the aft portions of the



Figure 3. Schlieren photograph of shuttle vehicle/exhaust plume interactions from 9-foot by 7-foot wind tunnel test.

vehicle were properly designed, and that they would safely function during ascent.

Other specialized aspects of Ames' wind tunnels were very helpful in the shuttle's development. Figure 4 shows multiple exposures of a special rig in the center's 14-foot tunnel that was used to study the aerodynamics of an abort maneuver implemented at transonic mach numbers. This rig also was used in the study of the mated/separating configurations between the En-

## 20th Space Shuttle Anniversary



Figure 4. Multiple-exposure photograph showing test positions of shuttle abort maneuver in the 14-foot tunnel.

terprise and the 747 carrier aircraft.

One of the most heavily used tunnels for shuttle testing was the 3.5-foot hypersonic wind tunnel, which was capable of simulating flight at Mach 5, 7 and 10. This facility provided about 47 percent of the total hours of wind tunnel testing at Ames. Many personnel were involved in this work, including Joe Marvin, Mike Horstman, Marvin Kussoy, Bill Lockman and Tom Polek. Figure

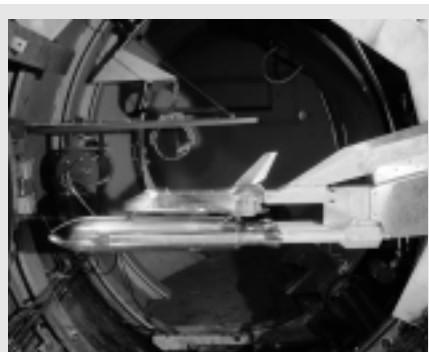


Figure 5. Shuttle ascent stack in the 3.5-foot hypersonic wind tunnel.

5 shows a 1.5 percent ascent stack configuration in the 3.5-foot hypersonic wind tunnel test section. This model was tested at Mach 5. Another configuration tested in the 3.5-foot tunnel was secured to the sting by its tail, so the effects of protruding main engines and the orbital maneuvering system could be assessed. These studies led to the understanding of many different complex phenomena, including dynamics of shock-shock interactions caused from the proximity of the elements of the stack configurations, and the effects of split body flap deployments and turbulent flows.

### Entry Aerodynamics and Aerothermodynamics

Before the space shuttle, most entry vehicles were relatively simple, blunt shapes with no aerodynamic control surfaces. The shuttle was to become the first airplane-like entry vehicle with movable control sur-

faces.

The 3.5-foot hypersonic wind tunnel contributed equally to both ascent and entry aerodynamics and entry aerothermodynamics. Figure 6 shows a shadowgraph of the side view of the orbiter at Mach 7. The fine lines enveloping the side view outline the front of a bow shock layer that forms over the vehicle. At higher Mach numbers, the bow wave is highly swept as shown in the figure, and the gases in this wave are



Figure 6. Shadowgraph of flow about the shuttle orbiter at Mach 7 showing the bow shock wave.

shock-heated to very high temperatures. These shock-heated gases create an environment that would melt the surface of the vehicle if it were made of materials such as aluminum or composites found in modern aircraft. Data and analyses from Ames' wind tunnel simulations later were used to refine methods for estimating the heating over the full-scale shuttle.

The entry aero/aerothermodynamics of the shuttle were performed before the advent of modern 3-dimensional real-gas computational fluid dynamics, a later accomplishment led by Ames. In the 1970s, personnel including John Howe, Chul Park, Dave Stewart, John Rakich and Mike Green, working under the leadership of Dean Chapman, Vic Peterson and Howard Larson, used clever, approximate analytical tools, experimental results and engineering judgment to model the aerodynamic forces, heating rates and heating loads to understand the shuttle entry flow environment. This knowledge was required for the development of the shuttle TPS, another area of key contribution by Ames.

### Thermal Protection System Contributions

The shuttle's thermal protection system prevents the vehicle from burning up from the searing heat of hot gases that exist within a bow shock layer that envelops the vehicle as it re-enters Earth's atmosphere. These gases reach temperatures as high as 25,000 degrees F, and heat the surface of the vehicle to as much as 3,000 degrees F. The vehicle enters the atmosphere at an angle of attack of about 40 degrees. Figure

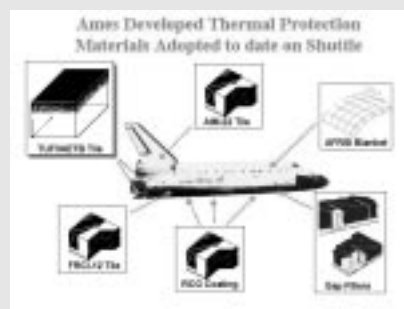


Figure 7. Ames' contributions to the space shuttle thermal protection system.

7 depicts the elements of the thermal protection system developed or invented by Ames. Key participants in this research include Howard Goldstein, Dan Leiser, Marnel Smith and Dave Stewart.

In the early 1970s, Ames and JSC evaluated a large number of candidate TPS materials for the space shuttle orbiter in their arc jet facilities. Among these new types of heat shield materials was the LI-900 silica tile system developed by Robert Beaseley and his team at Lockheed Missiles and Space Company, Sunnyvale, and several other conceptually similar systems developed by other companies. In order to understand why the various tile materials performed as they did in arc jet testing, Ames began a tile analysis research program, which rapidly turned into a tile development program. When the LI-900 tile system was chosen as the baseline in 1973, Ames had already begun to make significant contributions to the rapidly improving technology.

Ames showed in that same year how the purity of the silica fibers used in the tiles controlled their temperature capability and lifetime. In 1975, Ames invented the black borosilicate glass coating called Reaction Cured Glass (RCG) that was adopted by LMSC and the shuttle program in 1977 and that now covers two-thirds of the orbiters' surface. This coating provides a thermally stable high-emittance surface for the tiles, which serves to radiate away heat and allows the tiles to be manufactured to the demanding tolerance required. The coating covers the tile, which is made by bonding pure silica high temperature-resistant fibers. The finished tile substrate is similar in appearance and density to Styrofoam, but its thermal properties are such that the surface can be glowing white hot at over 2,300 degrees F and the back face of the tile never exceeds 250 degrees F, only a few inches below the surface. These remarkable heat-resistant tiles enable the space shuttle orbiter, which is essentially an aluminum airplane, to fly at hypersonic speeds.

In 1974, Ames invented the tile now

## 20th Space Shuttle Anniversary

known as LI-2200, which is stronger than LI-900 and contains silicon carbide to provide improved temperature capability. Adopted in 1978, this new tile replaced about 10 percent of the baseline LI-900 tile system on the first orbiter, Columbia, when a critical tile strength problem was encountered. Later, in 1977, Ames invented a new class of tiles called Fibrous Refractory Composite Insulation (FRCI 12). In 1980 it replaced about 10 percent of the earlier LI-2200 and LI-900, providing a more durable TPS and saving about 500 pounds of the overall TPS weight.

Hot gas flow between the tiles during atmospheric entry was considered a serious problem during orbiter development. In response, Ames developed a gap filler, which consists of a ceramic cloth impregnated with a silicone polymer that was adopted as a solution to the gap heating for Columbia. The Ames gap filler was so successful that it was adopted as a permanent solution to the gap flow problems on all the orbiters. In excess of 10,000 are now used on each vehicle.

On the leeward side of the orbiter, gases are much cooler during entry. At first a low temperature reusable surface insulation (LRSI) tile developed by LMSC was used. Ames (with Johns Manville) developed a flexible silica blanket insulation called Advanced Flexible Reusable Surface Insulation (AFRSI) that replaced most of the LRSI on the last four orbiters (Challenger, Atlantis, Discovery and Endeavour) and was retrofitted to Columbia.

### Arc Jet Facilities Simulate Entry Heating

Ames has a long heritage in the development of arc jets, tracing to the earliest days of NASA. These facilities are used to simulate the entry heating that occurs for locations on the body where the flow is brought to rest (the stagnation point, typically on the nose cap, wing leading edges and on the acreage of the vehicle). Simulations have to run from a few minutes to tens of minutes to understand the TPS materials' response to the hot gas flow environment. To support shuttle development, Dean Chapman and others led the effort to up-

grade Ames' capability. Ames' facilities group, including Howard Stein, Warren Winnovich and Frank Centolanzi, implemented the upgrades. Ames' 60 megawatt Interaction Heating Facility was brought on line in the mid-1970s. High-pressure air passes through the constricted arc heater (invented by Ames), where a "standing lightning bolt" is created and about 50 percent of this energy is deposited as heat into the flowing gas. The heated gases are expanded through either conical nozzles for stagnation point and wing leading edge testing (Figure 8), or through semi-elliptical nozzles for acreage tests. Ames' capability of being able to test a 2-foot by 2-foot section of the acreage tile field in conditions duplicating

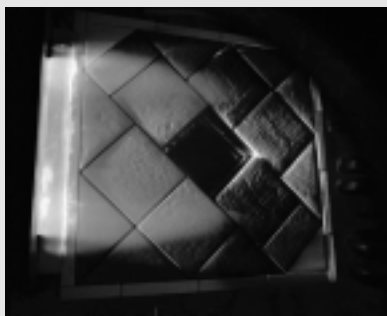


Figure 9. "Missing tile" heating test.

aeroconvective heating and reacting boundary layer chemistry during simulated entry conditions was a critical element in the development of the shuttle TPS. Figure 9 is a photograph of the "missing tile" test run to understand the effects that would occur should a tile be lost prior to entry.

### Low-Speed Descent Aerodynamics

Early shuttle concepts had orbiters that would have exhibited less than ideal aerodynamic characteristics upon return to Earth. This could have led to poor handling qualities, especially during approach and landing. Personnel at Ames with expertise in guidance and control tackled the challenge of developing concepts that might compensate for deficient aerodynamics and ensure adequate handling qualities.

Still glowing red hot from its high-speed entry, the orbiter slows and descends into the supersonic/transonic/subsonic regime of its return. Here again, Ames' wind tunnels played a key role in defining shuttle aerodynamics and design of the orbiter. The 2-foot transonic wind tunnel, with its capability up to Mach 1.4, was used to study potentially troublesome panel flutter problems. The 12-foot pressurized wind tunnel was used to investigate the orbiter's low-speed handling characteristics.

Ames' efforts demonstrated that

unpowered landings could be made at speeds of at least 200 knots without significant problems. The 12-foot wind tunnel was used to define the aerodynamics of a specially modified Gulfstream 2 (G2) business jet with direct-lift flaps and side force generators. This vehicle was used for flight tests and astronaut training. Ames' Convair CV 990 and the G2 aircraft were used to prove that the orbiter did not need a subsonic engine for fly-around landing capability, an important finding that avoided having to pay the weight penalty of hauling a landing engine, its fuel and supporting subsystem to orbit and back. The Gulfstream, now known as the STA (Shuttle Training Aircraft), is used to this day by pilot astronauts for in-flight proficiency training.

Finally, an awesome 36 percent scale model of the orbiter, 44 feet long, was fabricated and tested in Ames' 40- by 80-foot wind tunnel. Figure 10 shows the model, then painted yellow, in the test section with a person in view to give the scale. This model and the 40- by 80- wind tunnel could create Reynolds numbers



Figure 10. 36 percent orbiter model in the 40-foot by 80-foot wind tunnel

slightly higher than the 12-foot pressurized wind tunnel. An important purpose of the 40- by 80-foot testing was to identify the influence of the TPS on the orbiters' low-speed aerodynamics. This model still exists, painted with the striking black underbelly and white top. It is proudly displayed in front of the Ames Visitor Center, near the 40- by 80- where it was so intensely tested.

### Approach/Landing Systems Development: FSAA

Landing simulation research for the shuttle orbiter began in the very early 1970s, using the Flight Simulator for Advanced Aircraft (FSAA). The large motion envelope of the FSAA provided many of the vital cockpit accelerations that enabled pilot astronauts to experience a truer "feel" of the

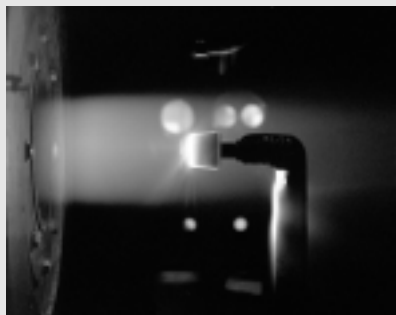


Figure 8. Stagnation point test

## 20th Space Shuttle Anniversary

g-forces of the orbiter during approach and landing. These simulations were conducted for that portion of the shuttle's flight from supersonic (following re-entry) to approach and landing.

For many years, prior to first flight, all the pilot astronauts who would eventually fly the orbiter spent many hours in the FSAA, identifying handling qualities that needed improvement, and control system shortcomings. In this process, the pilots gained invaluable training in the skills needed to successfully land the orbiter. It was in the FSAA that investigations were conducted that determined the need for the Heads-Up-Display (HUD), and its alphanumeric



Figure 11. Kenneth White in the Space Shuttle Vehicle Simulator (1970).

symbology that became the primary guidance system for orbiter landing. Figure 11 shows a very early (1970) photograph taken in the simulator when the shuttle work was just starting. Depicted is pilot Kenneth White in the Space Shuttle Vehicle Simulation Cockpit.

A pilot-induced oscillation (PIO) problem arose on the first approach and landing test program flight in July 1977, with pilots Fred Haise and Gordon Fullerton. A PIO is a longitudinal "porpoising" that worsens due to pilot over-control. It is generally not a piloting technique problem so much as a control system problem. On this first flight, as the oscillation began to diverge dangerously close to the ground, Haise had enough confidence and simulator training to simply let go of the controls and allow the oscillation to damp itself out.

Following that, a major investigation was conducted in the FSAA to re-evaluate the control systems gains, in order to minimize the possibility of future PIO problems. In addition, work was conducted for several years in the simulator to investigate the terminal area energy management concepts designed by engineers at JSC.

Development support for the space shuttle, prior to the first flight, also included approach/landing control system and handling qualities, heads-up display concept, speed brake scheduling, astronaut training, flight techniques for failure recovery, and

landings of the shuttle from atop the 747 carrier aircraft.

### Vertical Motion Simulator

In 1980, Ames' new Vertical Motion Simulator (VMS) began operation. It wasn't long before the VMS earned a reputation as the best simulator anywhere for the continuation of engineering design and shuttle pilot training. Landing systems and flight rules are done on the VMS with astronaut



Figure 12. "Streak" photograph of the simulator showing how the piloted cabin moves to give the "feel" of flight and landing.

crews and JSC engineers. Ames' SimLab and VMS have supported the shuttle program on a continuing and scheduled basis ever since.

### Work Supporting the Shuttle After the First Launch

Ames has continued to make major contributions to the shuttle program over the two decades following the flight of STS-1. This includes work in the area of aero/aerothermodynamics, where very significant, benchmarking CFD calculations were accomplished for the shuttle ascent stack configurations and for orbiter re-entry. CFD was a key contributor to the redesign of the space shuttle main engine.

In the area of TPS, a second-generation material called Toughened Unipiece Fibrous Insulation (TUFI) has been adopted and used to eliminate problems in regions of the orbiter where debris impact has proven to be an issue, especially on the aft heat shield and on the body flaps.

In piloted flight simulation, a very close working relationship developed between the orbiter engineering design people from JSC, the astronauts and Ames' SimLab. Vir-

tually every pilot astronaut cycled through the VMS sim. Every day, from one to four of the astronauts' T-38s would park on the ramp beside the SimLab building, and the pilots would come in early and work late. More time was provided for commanders and pilots who had a near-term flight on the schedule. Besides looking at future design improvements in the flight control systems, the pilots would encounter every conceivable failure mode the JSC engineers could imagine. This training proved invaluable in preparing shuttle commanders and pilots to deal with a wide array of possible landing failures. In addition to crew training, the VMS has supported redesign of the



Figure 13. Successful landing of Columbia at Dryden Flight Research Center.

brakes, nose wheel steering and Multifunction Electronic Display System (MEDS); engineering development of the drag parachute; flight control automation for the Extended Duration Orbiter; and "return to flight" studies after the Challenger accident.

Today, work continues on the shuttle in the areas of aero/aerothermodynamics, TPS, VMS support and cockpit upgrades.

### Conclusion

Space shuttle Columbia landed at Dryden Flight Research Center on April 14, 1981. The crew consisted of commander John Young and pilot Robert Crippen. The mission duration of 2 days, 6 hours, 20 minutes and 53 seconds included 36 orbits of the Earth. This first, brief mission proved the capability of the world's first and only reusable space vehicle, and the world's most reliable and versatile launch system.

Ames played a critical role in making the outstanding success of the space shuttle "happen," especially in the areas of aero/aerothermodynamics, thermal protection systems and piloted flight simulation areas. It is one element of the center's heritage that should be a source of pride to everyone at Ames.

By JIM ARNOLD AND ANN HUTCHISON,  
WITH CONTRIBUTIONS FROM HOWARD  
GOLDSTEIN, TOM ALDERETE AND JACK  
BOYD. THE ARTICLE ALSO CONTAINS  
INFORMATION FROM THE MAY 1, 1981  
ISSUE OF THE ASTROGRAM.



## Partnerships & Collaboration

# Ames steps boldly forward with NASA Research Park

*continued from front page*

sciences and microgravity, biotechnology, nanotechnology, aeronautics and space technology development, educational outreach, information sciences and technology, communications support, and commercial use and development of NASA research.

"Our goal is to develop a world-class shared-use research and development campus in association with academia, industry and non profits," said McDonald. "We can achieve this goal by creating a unique community of researchers, students, and educators who have a shared mission, in addition to pursuing their own organization's mission," he explained.

NRP partners must be committed to supporting NASA's mission by enhancing the agency's research leadership, by facilitating science

and technology education, and by assisting NASA's outreach efforts, according to Michael Marlaire, Ames' newly named Assistant Director for Development.

"Our objectives are to establish technical collaborations in key research areas, to create unique facilities for collaborations, to develop workforce enhancement programs, including joint appointments and internships, and to provide increased access to graduate students, post docs and future employees," Marlaire said. "Our partnerships with the University of California, Carnegie Mellon University, San José State University and Foothill-DeAnza Community College will facilitate the pursuit of our research and education objectives within the NASA Research Park," he added.

"Through the NASA Research Park, we can benefit the agency by optimizing the use of NASA property for mission purposes, by creating new opportunities for NASA education programs, and by leveraging resources to spread infrastructure costs," Marlaire pointed out. "Foremost, we will enhance NASA scientific research, increase technology advancement, and facilitate the commercialization of NASA technologies," he concluded.

Under the provisions of the new collaboration, negotiations for a land use agreement must be completed within 180 days. This agreement will establish all of the contractual relationships needed to construct

new buildings for the research collaborations. Cliff Imprescia, Ames' Director of the Office of Research and Development Services and Ames' Deputy Chief Counsel Tom Berndt, along with representatives and consultants from Marlaire's staff, will continue to lead the negotiation process.

The Lockheed Martin project is permitted under the Environmental Assessment conducted in accordance with Ames' 1994 Comprehensive Use Plan (CUP). As proposed, the project could include approximately 700,000 square feet of new construction in the NRP. Other NRP partners

**"This is the first step to the new Ames."**

**-- Dr. Henry McDonald,  
Center Director, Mar 22, 2001**

are participating in an environmental entitlement process called an Environmental Impact Statement (EIS) that NASA is currently conducting. The EIS would permit new construction, in addition to that allowed by the 1994 CUP.

EIS partners will be entitled to build in the NRP after completion of the EIS process. These partners include the University of California, Carnegie Mellon University, San José State University, Foothill-DeAnza Community College District, the National Association for Equal Opportunity in Higher Education and two non-profit organizations — the California Air and Space Center and the Computer History Museum Center. All of these organizations are interested in research collaborations and educational programs involving NASA. They are actively working with Ames to develop a "master plan" for the EIS-enabled portions of the NRP.

Several other high-tech industry companies are also considering research partnerships with Ames. In fact, Ames has established an NRP research collaboration working group to interact with industry and universities to determine potential research collaborations. Recently, the group held discussions with Intel Corp concerning its potential participation in the NRP.

Ames' chief scientist Dr. Stephanie Langhoff chairs the group. Other members include Office of Aerospace deputy director

Dr. Vic LeBacqz, Office of Information Systems deputy director Dr. Eugene Tu (Acting), Office of Astrobiology and Space Research deputy director Ken Souza, Commercial Technology Office chief Carolina Blake and Office of Information Systems manager of strategic partnerships Maylene Duenas.

Binding agreements with EIS partners cannot be executed until the record of decision completing the EIS process is signed, permitting construction and new development. Ames is currently working on the NASA Ames Development Plan, a comprehensive plan for

the development of the entire 2,000-acre site at Moffett Field. As part of the EIS process, Ames held public scoping meetings last summer to inform local communities about the development plan and to

solicit comments.

During the next few months, project consultants will analyze the plan for environmental impacts. Upon completion of the review process, the plan will be presented to the public during a series of hearings currently scheduled for this fall. After reviewing public comments, the NASA Ames Development Plan will be finalized. Following the expected signing of the "Record of Decision" in the spring of 2002, phasing of construction by EIS partners can begin.

NASA Research Park will benefit all partners by leveraging research resources through collaborative activities, by providing a unique location for transfer of scientific and engineering ideas, and by establishing closer linkages between industry and academia, according to Marlaire.

"The American people will benefit from the research and formal education aspects," Marlaire said. "In addition, they will receive increased opportunities for public involvement and understanding of science, technology and exploration through the universities and the non-profit organizations, including the California Air and Space Center and the Computer History Museum Center, proposed at NASA Research Park."

BY MICHAEL MEWHINNEY  
AND DAVID MORSE



### Is exchange membership in your future?

Have you ever wondered what the Ames Exchange is? Or what it does? Have you been curious as to how funds are raised and disbursed to support morale and welfare activities at Ames?

Simply put, the Ames Exchange is a non-profit employee association that has two main thrusts. First, the Exchange operates a number of businesses at the Center — including the cafeteria, the swimming pool, catering services, two gifts shops, and overnight lodging facilities (the Exchange Lodge). Second, the Exchange uses monies raised to fund recreation and morale-build-

ing activities for Ames civil servants, contractors, students, retirees and employee families.

The Exchange Council is the "board of directors" that oversees the business operations of the Exchange. At this time, the Exchange Council is looking for a few new members. Candidates of diverse backgrounds, job types, job levels and viewpoints from different codes across Ames are being sought. Although the Exchange represents and supports everyone at the Center, the status of the Exchange as a "government instrumentality" requires that mem-

bers of the Council be civil servants.

The Exchange Council meets twice a month at lunch to consider business and strategic issues. Exchange Council members serve three-year terms at the pleasure of the Center Director.

If you think Exchange Council membership might be of interest to you, please contact the Exchange operations manager, Deb Renick, at ext. 4-0290 ([drenick@mail.arc.nasa.gov](mailto:drenick@mail.arc.nasa.gov)) or council deputy chair, David Morse, at ext. 4-4724 ([dmorse@mail.arc.nasa.gov](mailto:dmorse@mail.arc.nasa.gov)). Please respond by April 20.

AMES EXCHANGE COUNCIL



### NASA-industry team improves supercomputers to reach for dreams

Simulating life's beginning and accurately predicting hurricane paths are two distant dreams that came a small step closer to reality when Ames Research Center recently was first to "boot" what may be the most powerful parallel supercomputer of its kind.

Able to calculate airflow around an aircraft in a day instead of a year, the "SGI 512-processor Origin 3000" came to life on March 23. Ames contributed innovations to previous test bed machines that helped make the 512-processor computer possible. To many people, the most impressive products of supercomputers like the Origin are animations that are the envy of Hollywood; but to scientists these ever-faster, electronic minds have the ability to unlock nature's secrets.

"What used to take a year to calculate on a single processor might be done in less than a day on a 512-processor machine," said Chris Henze of Ames, who is working on simulations of protein formation with colleague Andrew Pohorille.

"Nevertheless," said Henze, "with current supercomputer power it takes months or years of calculations to simulate how even a small protein molecule folds into a certain shape. This is important because a protein's shape largely determines what the protein can do, such as make muscles move or allow the immune system to recognize intruders. In the future, with even more powerful supercomputers, we hope to be able to design protein molecules with specific shapes and jobs."

The 512 will lead to faster and better development of spacecraft, according to John Ziebarth, deputy chief of the Numerical Aerospace Simulation Division at Ames. "With large NASA computer codes, we are

getting 10 times improvement in performance," he said.

"In one project underway at Ames, NASA scientists will be able to see important features in hurricanes," said Ames computer scientist Bob Ciotti.

"Data from satellites and other observations analyzed on this class of machines will help us learn how to better predict hurricane behavior, or better answer important questions about global climate change," said Ciotti.

Though the 512 greatly improves and speeds computations, Ames scientists continue to advance the supercomputing state-of-the-art with partner SGI, Mountain View, CA. NASA and SGI have been cooperating under a "memorandum of agreement" since 1998. "SGI is proud to be partnered with Ames and their world-class scientists and engineers to help them analyze and solve America's most complex problems," said Anthony Robbins, president, SGI Federal.

For the last few years, Ames computer scientists have encouraged SGI to connect many computer processor chips in a new way when building the largest of SGI's parallel supercomputers. These machines include many central processing unit (CPU) chips instead of just one or a few CPUs like older supercomputers. Within the last five years, microprocessors have become much more powerful, and computer makers have found that building a supercomputer with thousands of processors is cost effective. But making it work efficiently has been a problem until now.

"The solution," Ziebarth said, "was to suggest to SGI that it modify its computer systems to act as if each had one large memory even though, in reality, each has a large number of memory units."

"We call this a 'single system image' (SSI)," Ziebarth said. Ames also encouraged SGI to combine pairs of parallel supercomputers into even bigger single machines. "We said to SGI, if you'll build a 512-CPU system using SSI, then we have a technique that will speed up processing about 10 times," he said. Earlier, NASA Ames programmer Jim Taft invented the technique, shared memory multi-level parallelism, that greatly simplifies authoring software for modern parallel-processor supercomputers by enabling easy communication across many CPUs.

To make the prototype 512 machine, Ames and SGI combined two 256-processor machines. Commercially available 512 machines, including the Origin 3000 that was booted this month at Ames, resulted from the experience gained in making the prototype. In a few days, the Army is expected to boot two more Origin 3000 512-machines, the second and third of their kind.

In the next few months, Ames and SGI will connect two commercial 512 machines to make a test bed 1024 SSI computer. "According to our projections, the 1024-processor machine could deliver about twice the performance of the 512," said Bill Feiereisen, chief of the Ames Numerical Aerospace Simulation Division.

Stunning images, animation and additional technical information about NASA Ames' supercomputer efforts are available on the Internet at these URLs:

<http://www.nas.nasa.gov/About/Media/medialibrary.html> or at:

<http://www.nas.nasa.gov/gridpoints>.

BY JOHN BLUCK



## Event Calendar

**Model HO/HOn3 Railroad Train Club** at Moffett Field invites train buffs to visit & join the club in Bldg. 126, across from the south end of Hangar One. Work nights are usually on Friday nights from 7:30 p.m. to 9:30 p.m. Play time is Sunday from 2 p.m. to 4 p.m. For more info, call John Donovan (408) 735-4954 (W) or (408) 281-2899 (H).

**Jetstream Toastmasters**, Mondays, 12 noon to 1 p.m., N-269/Rm. 179. Guests welcome. POC: Samson Cheung at ext. 4-2875 or Lich Tran at ext. 4-5997.

**Ames Ballroom Dance Club**. Tuesdays: West Coast Swing 4/3, 4/10, 4/17, Cha Cha AND Casino Rueda 4/24, 5/1, 5/8, Foxtrot 5/15, 5/22, 5/29, East Coast Swing and Jive 6/5, 6/12, 6/19, Paso Doble 6/26. 3 levels of classes, from Beg. to Int., 5:15 - 6:45pm. Classes in Building 944, the Recreation Center. Women dancers encouraged to join. POC: Helen Hwang, hhwang@dm1.arc.nasa.gov.

**Ames Bowling League**, Tuesdays, at 6 p.m. at Palo Alto Bowl. Bowlers needed. POC: Mina Cappuccio at ext. 4-1313 or Carmen Park at ext. 4-1215.

**Ames Diabetics (AAD)**, meet twice a month on first & third Wednesdays, 12 noon to 1 p.m., in the Ames Café, far corner of Sun room. Peer support group that discusses news that affects diabetics, both type I and II & exchange experiences in treatment & control & help each other best cope with the disease. No cost, sales people, leader or medical professionals. Attend a meeting or call Bob Mohlenhoff at ext. 4-2523, or email him at bmohlenhoff@mail.arc.nasa.gov.

**Ames Child Care Center Board of Directors Mtg**, Every other Thursday (check website for meeting dates: <http://acc.arc.nasa.gov>), 12 noon to 2:00 p.m., N269, rm. 201. POC: Katharine Lee, ext 4-5051.

**NFFE Local 997 Union General Mtg**, Apr 18, noon to 1 p.m., Bldg. 19/Rm. 2017. Guests welcome. POC: Marianne Mosher at ext. 4-4055.

**Ames Amateur Radio Club**, Apr 19, 12 noon, T28-N (across from N-255). POC: Michael Wright, KG6BKF, at ext. 4-6262. URL: <http://hamradio.arc.nasa.gov>

**Native American Advisory Committee mtg**, Apr 24, 12 noon to 1 p.m., Ames Café. POC: Mike Liu at ext. 4-1132.

**Ames Contractor Council Mtg**, May 2, 11 a.m., N-200 Comm. Rm. POC: David Lawrence at ext. 4-6434.

**Environmental, Health and Safety Monthly Information Forum**, May 3, 8:30 a.m. to 9:30 a.m., Bldg. 19/Rm 1040. POC: Linda Vrabel at ext. 4-0924.

**Nat'l Association of Retired Federal Employees (NARFE), San Jose Chapter #50, Mtg**, May 4, at Hometown Buffet, Westgate Mall, 4735 Hamilton Av, San Jose. Prog. & bus. mtg. at 9 a.m., followed by lunch, \$6.27, in a reserved area. Program starts at 9:30 a.m. followed by lunch. POC: Mr. Rod Perry (650) 967-9418 or NARFE 1-800-627-3394.

## Ames Classifieds

Ads for the next issue should be sent to [astrogram@mail.arc.nasa.gov](mailto:astrogram@mail.arc.nasa.gov) by the Monday following publication of the present issue and must be resubmitted for each issue. Ads must involve personal needs or items; (no commercial/third-party ads) and will run on space-available basis only. First-time ads are given priority. Ads must include home phone numbers; Ames extensions and email addresses will be accepted for carpool and lost & found ads only. Due to the volume of material received, we are unable to verify the accuracy of the statements made in the ads.

### Housing

3 bd/1.5 ba, 2-story townhouse on Luz Avenue, San José. Freshly painted inside, dishwasher, gas heat, w/w carpeting, outside child play area/large patio. 1 car port. Easy access to H101/680/280. \$295K. Azucena Guzman (408) 559-2881.

NRC senior research associate & spouse seek a furnished 2 bdrm apartment or house, Feb 1 to end July 2001. Interested in buying/leasing a cheap, used car for this period. Sophie Wuergler, email to: [s.m.wuergler@keele.ac.uk](mailto:s.m.wuergler@keele.ac.uk) or phone (+44 1782 752299 or +44 1782 584214) or by fax (+44 1782 583055).

Pleasant furnished room for rent in home in the Los Gatos/Campbell corner of San José for considerate, professional non-smoker or outside smoker. Off-street parking, safe family neighborhood, central heat/air, utilities included. Long term preferred, shorter term possible for spring/summer. Shared bath/kitchen. Lease/deposits required. Call (408) 266-7272 and lv. message.

Seeking roommate, nice 1 bdrm & kitchen privileges in gorgeous 2 bdrm townhouse, near DeAnza. \$775/month, available 4/15/01. Tammy (408) 366-0826.

Quiet, tidy undergraduate male seeks a room to rent or sublet for the period of approximately June 1 to Sept 5th. Visiting Ames over the summer to work on a research project, so a place within a half-hour drive of Moffett would be preferable. Paul Gosling: e-mail at: [pgosling@mail.arc.nasa.gov](mailto:pgosling@mail.arc.nasa.gov) or call (410) 516-2784.

### Transportation

'00 Montero Sport LS 4WD, 10,500 mls. Air conditioning, alarm system w/engine immobilizer. Engine: V6, 24V, SFI, 3.0 Liter. Exterior Color Solano Black Pearl. Asking price: \$22,000. For more information, call Darwin (408) 964-3916 (cell).

### Miscellaneous

Wanted as props for cyberpunk themed wedding reception: Old televisions any size capable of displaying a video feed or static. Age, size quality of picture, and functional sound are not an issue. Units will be donated to Salvation Army after event. Dennis (408) 623-9791 [cel].

Rototiller, Merry Tiller Suburban, 5 hp, only used twice, \$350 (\$750 new). Call (650) 941-8013.

Aquariums (55, 25 & 10 gallon) with all gear, pumps, filters, gravel, etc. \$100 for everything; Very nice and plush queen mattress, \$25; beautiful 4'x6' glass dining table, \$100. Call (650) 341-2123.

### Ames Retirements

| Name             | Code | Date    |
|------------------|------|---------|
| Larry A. Manning | S    | 3-30-01 |
| Beverly G. Akins | SF   | 3-31-01 |
| Carol A. Byers   | JTN  | 4-03-01 |

Used sofa w/ fold-out full sized bed. \$25. U-haul. Call (650) 962-9031.

INN VISION, an emergency shelter for women and families desperately needs donations of large and extra-large size women's clothing, and baby items of any kind. Drop-off during daytime hours at 66 E. Rosemary in San José. Call (408) 271-1630. Sigrid (408) 296-6235.

Running Shoes, Asics Gel MC plus, size 9 men's. Never been worn. \$65. Call (408) 257-6487.

HealthRider Fitness machine, deluxe model, excellent condition. \$150. Call (650) 947-8124 evenings or weekends.

Kid's wetsuits: Brand new O'Neill youth size 14, \$85; Used very good condition Billabong youth size 12, \$35/BO. Call (831) 423-5824.

### Lost & Found

Moffett Field Lost and Found may be reached at ext. 4-5416 at any time. Residents and employees at Ames may also use Internet browser at: <http://ccf.arc.nasa.gov/codejp/pages/lostFound.html> to view a list of found property and obtain specific instructions for reporting lost or found property and how to recover found property. Call Moffett Field security police investigations section at ext. 4-1359 or email at: [mfine@mail.arc.nasa.gov](mailto:mfine@mail.arc.nasa.gov)

### Ames public radio

1700 KHz AM radio -- information announcements & emergency instructions, when appropriate, for Ames employees.

## Astrogram deadlines

All Ames employees are invited to submit articles relating to Ames projects and activities for publication in the *Astrogram*. When submitting stories or ads for publication, submit your material, along with any questions, in MS word by e-mail to: [astrogram@mail.arc.nasa.gov](mailto:astrogram@mail.arc.nasa.gov) on or before the deadline.

| Deadline    | Publication |
|-------------|-------------|
| Mon, Apr 16 | Mon, Apr 23 |
| Mon, Apr 30 | Mon, May 7  |
| Mon, May 14 | Mon, May 21 |
| Mon, May 28 | Mon, Jun 4  |
| Mon, Jun 11 | Mon, Jun 18 |

## Exchange Information

Information about products, services and opportunities provided to the employee and contractor community by the Ames Exchange Council.

### Beyond Galileo (8 a.m. to 2 p.m.)

Stop by and see our new gift shop in Bldg. N-235. New items arriving every day. Sundries on hand for those at-work emergencies, i.e. aspirin, cough medicine, etc.

### Café Specials N-235 (6 a.m. to 2 p.m.)

- Spring ham luncheon, April 12
- Books are Fun Book Fair, April 23 & 24, 11:00 a.m. to 2:00 p.m.
- BBQ season is almost here again. Remember the Ames Café can meet all your BBQ needs. Call ext. 4-2161.

### Visitor Center Shop (8 a.m. to 4 p.m.)

NASA logo merchandise, souvenirs, toys, gifts and educational items.

### Tickets, etc... (8 a.m. to 4 p.m.)

Now open 8am-2pm in the Beyond Galileo gift shop for transit and entertainment tickets. Tickets are now available for Disneyland and the new California Adventure Park. Call for info and prices. Following are upcoming events:

- San José Sabercats Arena Football-Don't miss the season opener.
- Sat. April 14 7:30 p.m. Los Angeles Avengers vs. Sabercats. Lower-level seat at discount price, \$15.
- Best of Broadway--Saturday Night Fever, Sun. April 15, Matinee, Orpheum Theatre
- San Francisco Giants- PacBell Park, Sat. May 26 vs .Colorado 1:05 p.m., Fri. Sept. 28 vs. San Diego, 7:35 p.m. View level seats available.

### NASA Lodge (N-19) 603-7100

Open 7 days a week, 7:00 a.m. to 10 p.m. Reasonable rates.

### NASA Swim Center (N108) 603-8025

The swimming pool is a beautiful place to hold your next office party! Life guards needed, must be 16 years old. Current lifeguard certifications are required. Great summer job!

### Vacation Opportunities

Lake Tahoe-Squaw Valley townhse, 3bd/2ba, view of slopes, close to lifts. Wkend \$490, midwk \$180 nite. Includes linens, firewood. Call (650) 968-4155 or e-mail DBMcKellar@aol.com

South Lake Tahoe cottage with wood fireplace and hot tub. Rates from \$50 to \$130 per night. Call (650) 967-7659 or (650) 704-7732.

# Celebrate Earth Day 2001 at Ames

This year, Ames has chosen to celebrate local biodiversity and efforts to conserve that biodiversity--the San Francisco Bay Area's flora and fauna. What follows is a list of Earth-day events planned at Ames for the week of April 16:

Date: Tuesday, April 17,  
11:30 a.m. – 12:30 p.m.\*  
Event: Ames wildlife biologist Chris Alderete will lecture on the center's most high-profile species, the burrowing owl.  
Place: Building 245, Room 272 (auditorium)

Date: Wednesday, April 18,  
11:30 a.m. – 12:30 p.m.\*  
Event: Don Edwards Wildlife Refuge project manager Clyde Morris will discuss 'Wildlife and Efforts to Restore Wildlife Habitat in the South San Francisco Bay'  
Place: Building 245, Room 272 (auditorium)

Date: Thursday, April 19,  
9:00 – 10:30 a.m.  
and 3:00 – 4:30 p.m.\*  
Event: Bird hike with Ames wildlife biologist Chris Alderete  
Place: Meet at the soccer field next to Building 245  
You must register at: <http://q/qe/events/ED/> or call Julie Quanz for this



event and please bring appropriate gear.

Date: Thursday, April 19,  
11:00 a.m. – 2:00 p.m.\*  
Event: Earth Day exhibit booths, raffle, music and fun.  
Place: Durand Road

For more information, see <http://q/>  
\*Hearing impaired services can be provided upon request. Contact Julie Quanz at ext. 4-6810 ([jquanz@mail.arc.nasa.gov](mailto:jquanz@mail.arc.nasa.gov))

### THE AMES *Astrogram*

The Ames ASTROGRAM is an official publication of the Ames Research Center, National Aeronautics and Space Administration.

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**Editor.....Astrid Terlep**

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Printed on recycled and recyclable paper with vegetable-based ink.